MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

TMA1401 – MATHEMATICS FOR INFORMATION SYSTEMS I

(All sections / Groups)

16 OCTOBER 2019
2.30 pm – 4.30 pm
(2 Hours)

INSTRUCTION TO STUDENT

1. This question paper consists of 5 printed pages (inclusive of the front page) with 4 questions only. Page 5 is the appendix for the logical equivalence laws.
2. Attempt **ALL FOUR** questions. The distribution of the marks for each question is given.
3. Please print all your answers in the Answer Booklet provided.
4. Show **ALL** of your working steps clearly.

QUESTION 1 [TOTAL: 10 MARKS]

a) Let the universal set $U = \{1,2,3,4,5,6,7,8,9,10\}$, set $A = \{x \mid x \text{ is a prime number}\}$ and set $B = \{x \mid x \text{ is a multiple of } 3\}$.

i) List all the elements of A and B. [2 marks]

ii) Find $A \Delta B$. [1 mark]

iii) Draw sets U, A and B using a Venn diagram. Place the elements of the sets in correct regions and shade the region(s) that belong to $A \Delta B$. [1.5 marks]

b) Suppose $R = \{(5,5),(5,6),(6,5),(6,7),(7,5),(7,6),(7,7)\}$ is a relation on the set $A = \{5,6,7\}$.

i) Is R reflexive? Justify your answer. [1 mark]

ii) Is R symmetric? Justify your answer. [1 mark]

iii) Is R transitive? Justify your answer. [1 mark]

c) Consider the following function f:

$f : \{x \in Z \mid -1 \le x \le 2\} \to \{y \in Z^+ \mid y \le 6\}; \quad f(x) = x^2 + 2$.

i) List all the elements of domain, codomain and range of f. [1.5 marks]

ii) Is f one-to-one? Justify your answer. [1 mark]

QUESTION 2 [TOTAL: 10 MARKS]

a) Consider the vector $\mathbf{a} = \langle 2,5,1 \rangle$ and vector $\mathbf{b} = \langle 9,-3,6 \rangle$.

i) Find the dot product $\mathbf{a} \cdot \mathbf{b}$. [1 mark]

ii) Determine the angle θ in degree between $\mathbf{a}$ and $\mathbf{b}$. [3 marks]

b) Find the parametric equations for the line passing through point $A = (1,8,-2)$ and parallel to vector $\mathbf{a} = -7\mathbf{i} - 8\mathbf{j}$. [1.5 marks]

c) Solve the following system of linear equations using Gaussian elimination with back-substitution.

$$\begin{aligned} x + 2y + z &= 5 \\ -4y + z &= 2 \\ 4x + 4y + 3z &= 26 \end{aligned}$$

[4.5 marks]

Continued ...

QUESTION 3 [TOTAL: 10 MARKS]

a) Use logical equivalence laws to show that the propositions $\neg p \wedge \neg q$ and $\neg(p \vee (\neg p \wedge q))$ are logically equivalence. [4 marks]

b) Given the predicate $P(x, y) : y = \dfrac{5}{x+1}$ where $x, y \in \mathrm{N}$. Determine the truth values of the following statements. Explain each of your answer.

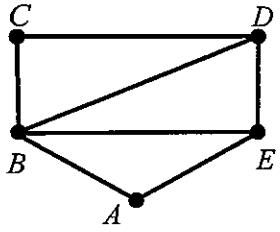
i) $\exists y\, P(0, y)$ [1 mark]

ii) $\forall y \exists x\, P(x, y)$ [1 mark]

c) Use the mathematical induction to show that $1+3+5+...+(2n-1) = n^2$ for all positive integers n. [4 marks]

QUESTION 4 [TOTAL: 10 MARKS]

a) Consider the following graph G:



i) Find the degree of each vertex. [1 mark]

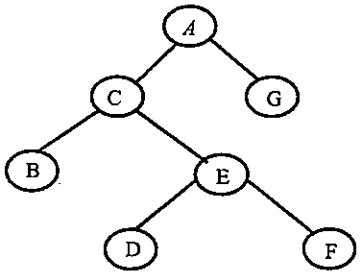
ii) Find an Euler circuit for G if it exists or explain why it doesn't have one. [1 mark]

iii) Find a Hamiltonian circuit for G if it exists or explain why it doesn't have one. [1 mark]

Continued ...

QUESTION 4 (continued)

b) Suppose vertex A is the root for the following binary tree:



Find the visitation order for the tree using the following methods:

i) In-order traversal [1 mark]

ii) Post-order traversal [1 mark]

[Important: For Questions 4c and 4d, you must show proper steps on how to compute the answers.]

c) An advertising company receives 150 applications from graduates for jobs in developing multimedia content. Suppose that 70 of these applicants majored in computer science, 55 majored in information system, and 12 majored both in computer science and in information system. How many of these applicants majored neither in computer science nor in information system? [1.5 marks]

d) The door on the computer graphic lab has a lock which has seven buttons numbered from 1 to 7. The combination of numbers that opens the lock is a sequence of non-repeated four numbers and is reset every month.

i) How many combinations are possible? [1 mark]

ii) How many combinations are possible if it cannot contain number 3? [1 mark]

iii) How many combinations are possible if it must starts either with number 6 or number 7? [1.5 marks]

Continued ...

Appendix

List of Logical Equivalence Laws

Conversion of Implication: $p \rightarrow q \Leftrightarrow \neg p \vee q$

Conversion of Equivalence: $p \leftrightarrow q \Leftrightarrow (p \rightarrow q) \wedge (q \rightarrow p)$

Double Negation: $\neg \neg p \Leftrightarrow p$

DeMorgan :
(i) $\neg (p \wedge q) \Leftrightarrow (\neg p \vee \neg q)$
(ii) $\neg (p \vee q) \Leftrightarrow (\neg p \wedge \neg q)$

Domination :
(i) $p \wedge F \Leftrightarrow F$ (ii) $p \vee T \Leftrightarrow T$

Negation :
(i) $p \wedge \neg p \Leftrightarrow F$ (ii) $p \vee \neg p \Leftrightarrow T$

Identity :
(i) $p \wedge T \Leftrightarrow p$ (ii) $p \vee F \Leftrightarrow p$

Commutative :
(i) $p \wedge q \Leftrightarrow q \wedge p$ (ii) $p \vee q \Leftrightarrow q \vee p$

Idempotent :
(i) $p \vee p \Leftrightarrow p$ (ii) $p \wedge p \Leftrightarrow p$

Distributive :
(i) $p \wedge (q \vee r) \Leftrightarrow (p \wedge q) \vee (p \wedge r)$
(ii) $p \vee (q \wedge r) \Leftrightarrow (p \vee q) \wedge (p \vee r)$

Associative :
(i) $p \vee (q \vee r) \Leftrightarrow (p \vee q) \vee r \Leftrightarrow p \vee q \vee r$
(ii) $p \wedge (q \wedge r) \Leftrightarrow (p \wedge q) \wedge r \Leftrightarrow p \wedge q \wedge r$

Absorption :
(i) $p \vee (p \wedge q) \Leftrightarrow p$
(ii) $p \wedge (p \vee q) \Leftrightarrow p$

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